Exploring the potential of trans fats policies to reduce socio-economic inequalities in coronary heart disease mortality in England

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Talk outline

• Trans fats

• Modelling Health outcomes

• Modelling cost effectiveness

• Comparing trans fats policies
Coronary Heart Disease

- Huge burden of disease
- ↓Mortality rates, halved over two decades
- BUT Inequalities persisted & even worsened
- 50% mortality fall due to risk factor reductions
- Major Risk Factors:
  - Diet: Trans Fats, Salt, Sugar, Sat Fat, Fruit & Veg
  - Tobacco
  - Excess Alcohol
  - Physical Inactivity

Bajekal et al Plos Med 2012
Coronary Heart Disease

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  – Tobacco
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Bajekal et al Plos Med 2012
Dietary Trans Fats

• Hydrogenated vegetable oils
• ↑CHD risk more than any other macronutrient
• ↑ $1\%_E$ in daily energy intake ↑CHD mortality 12%
• UK – ‘voluntary regulation’ & ‘better labelling’
  – Intake halved 1.4% ↓ 0.7% daily energy
  – BUT socio-economic gradients in intake

National Diet and Nutrition Survey published May 2014
Trans fats Policy - UK

- UK – ‘voluntary regulation’
  - Intake halved over past 10 years
  - Later absorbed into Responsibility Deal
Global Trans Fats Policies

(summary)

• Full legislative bans
  – Denmark (2004), Austria & Switzerland (2009)
  – Iceland (2010), Hungary & Norway (2014)
  – USA (Labelling from 2008, GRAS* from 2015)

• Partial Ban
  – NYC (2008), voluntary then mandatory

• Labelling
  – Brazil (2003)

*no longer recognised as GRAS (Generally Recognised As Safe)
• What are the potential health benefits of reducing dietary Trans Fats consumption in the UK?
Methods

• Population level reduction in TF intake by 1% and 0.5%
• Modelling approach
• Mortality counterfactuals
• Beta coefficient for risk factor intervention
• Stratified by age, gender, SEC
  – First modelling equal TF intake
  – Second modelling unequal TF intake
Methods II

• Outputs:
  – Deaths prevented or postponed
  – Life Years Gained
  – Hospital Admissions

• Results tested in Probability Sensitivity Analysis
Results

• 1% reduction in TF consumption:
  – 3,900 DPPs
  – 42,000 LYGs
  – 10,000 Fewer Hospital Admissions

  – Per year!
  – 0.5% reduction still yields large health gains
Life years gained (LYG) with a 1% and 0.5% reduction in daily energy intake of trans fats. Life years gained (LYG) by age and sex.
Would a reduction in TF consumption Affect Inequalities?

- DPPs Index with a 1% reduction in daily energy intake of trans fats intake. DPPs by age, gender and socio-economic circumstance assuming equal TF intake.

Would a ban on Trans Fats be cost effective?

- Estimated the population benefits, and cost effectiveness from 2011-2020 of:
  - Legislative ban on TFA (0% intake)
  - Mandatory reformulation (0.4% intake)
    - First modelling equal TF intake
    - Second modelling unequal TF intake
- Modelling approach
- Mortality counterfactuals
- Beta coefficient for risk factor intervention
- Stratified by age, gender, SEC
Methods: Costs

- Govt costs - Initial legislation + Annual monitoring
- Industry costs – reformulation + annual cost
- **Savings:**
  - Direct healthcare savings – reduction in hospital admissions
  - Informal care savings
  - Averted productivity loss
- All outputs discounted at 3.5%
Results

• Legislative ban:
  – 27,200-29,000 life years
  – 17,700-19,300 QALYs
  – 68,000-72,000 hospital admissions averted

• Costs:
  – Govt: £22m - £27.2m
  – Industry: £0- - £140m
Cost effective?

• Cost effective:
  – Cost saving + QALYs = dominant scenario
  – £1,400-£1,600/LYG (conservative cost only)
    • Statins £27,000/LYG 1° prevention
  – $0.7 - $7 per capita (PPP)
    • WHO ‘extremely cost effective’ < 1 x GDP per capita = $16,000 PPP
Cost effectiveness plane

Cost effectiveness of a legislative ban (1&2) or mandatory reformulation (3&4) on TFA, with equal (1&3) and unequal (2&4) intake across SEC quintiles.
• Exploring the potential of trans fats policies to reduce socio-economic inequalities in coronary heart disease mortality in England: A cost-effectiveness modelling study
Methods

• Estimated population benefits, & cost effectiveness from 2015-2020 of:
  – Legislative ban on TFA
  – Partial ban – restaurants
  – Partial ban – fast-food
  – Improved labelling

• Outputs
  – Deaths prevented or postponed (DPP)
  – Quality Adjusted Life Years
  – CHD subgroup ‘utility values’
Socio-economic inequalities

• **Stratified by age & gender**
  – Socio-economic circumstance
    (Index Multiple Deprivation IMD) quintiles

• **Slope index**
  – ‘absolute inequalities’ in mortality across SEC quintiles
Trans Fats Modelling Approach

Food Policy

Risk Factor Change

CHD Mortality & Incidence Change

Trans fat intake

Stratified by Socioeconomic Circumstance

e.g. Ban Tranfs fat

↓ CHD deaths & events
Trans Fats in England

• Average consumption approx. 0.7% Energy
  – National Diet & Nutrition Survey
  ≈ 0.3%E from industrial trans fats
  ≈ 0.4%E from ruminants (ie. meat & dairy products)

• Lower SEC groups probably higher consumption
  (Low Income Diet & Nutrition Survey)

<table>
<thead>
<tr>
<th></th>
<th>High SEC</th>
<th>SEC2</th>
<th>SEC3</th>
<th>SEC4</th>
<th>Low SEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>TF %E</td>
<td>0.5 %</td>
<td>0.6 %</td>
<td>0.7 %</td>
<td>0.95 %</td>
<td>1.2 %</td>
</tr>
<tr>
<td>Resulting TF%E</td>
<td>0.4 %</td>
<td>0.4 %</td>
<td>0.4 %</td>
<td>0.4 %</td>
<td>0.4 %</td>
</tr>
</tbody>
</table>
Methods: Costs

• Government costs = Initial legislation + Annual monitoring
• Industry costs = reformulation + annual costs
• Savings
  – Direct healthcare savings & reductions in hospital admissions
  – Informal care savings
  – Averted productivity loss – ‘frictional period’

• All outputs discounted at 3.5%
Uncertainty

• Probabilistic Sensitivity Analysis

• Assume statistical distribution for key parameters

• 10,000 simulations
  – Computation time not a problem (~minutes)
  – Memory limitation (≤4GB can be a problem)

• Report 95% confidence intervals
Results

• Mortality - Deaths Prevented or Postponed (DPPs)
  – Total Ban 7,200 (↓ 2.5%)
  – Labelling 3,500-2,200
  – Fast food 2,600
  – Restaurant 1,800

• CHD inequalities decreased
  ↓ 3000 total ban (↓ 15%)
  ↓ 600, restaurant ban (↓ 3%)
Results – Deaths Prevented or Postponed (DPPs)
Costs

• **State costs:**
  – £5m implementation + £2.4m annual monitoring
    • £21.6m over 5 year period

• **Industry costs:**
  – Worst case:
    • £25,000 per product, altering 8,000 product lines
    • £200m
  – Best case:
    • Reformulation absorbed in natural product Reformulation cycle
    • £0
Savings

• Direct Healthcare:
  £42m (ban)
  £11m (partial ban – restaurant)

• Informal Care:
  £53m to £196m

• Averted Productivity Loss
  £16m to £59m
Results – All Cost-effective or cost-saving QALYs
Does ↓ TFA consumption ↓ Inequalities?
Study strengths

• Results consistent with previous estimates
• Considers entire adult population
• Reliable datasets
• Novel modelling & stratification of population level interventions
• Use of APC mortality projections – may produce conservative estimates of mortality gains
Limitations

BUT

• Area level SEC categorisation
• Assumes instantaneous effect
• Ruminant TFAs Harmless? Unchanged?
• Effective implementation strategies?
Why Tackle Trans fats?

• Key part of dietary policies to ↓CHD
• ‘Low hanging fruit’ in prevention policies
• Substantial reductions in inequalities
Conclusions

• All policies evaluated would reduce CHD mortality

• And be cost effective

• A legislative ban would be the most effective and equitable policy
  – CHD mortality ↓ 2.5%
  – ↓14% CHD mortality inequalities
  – Savings £15,000 per QALY
Acknowledgements

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  – University of Glasgow

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  – St George’s, University of London

• Kirk, Allen, Martin O’Flaherty & Simon Capewell
  – University of Liverpool
Thank you
Dietary Industrial Transfat reduction
Estimated effects of different policy options
Coombes BMJ 2011 343 d55677

- Comprehensive interventions + Regulation (Denmark)
- Restaurant restrictions plus Food Labelling (USA)
- Restaurant restrictions (USA)
- Food Labelling (USA)
- Food Labelling (NYC)
- Voluntary Reformulation (UK)
- Voluntary Reformulation (NYC)
- Primary care advice

Downstream → Upstream policies
Responsibility Deal (RD)

• Public-private partnership
• Voluntary agreement
• **Food**, alcohol, physical activity, health at work
• Signatories report progress each spring
RD - Food

• Trans fats reduction
• Out of home calorie labelling
• Salt reduction
• Calorie reduction
• Fruit and vegetables
• Front of pack labelling
• Saturated fat reduction
RD Evaluation

• ‘pledges could be effective if fully implemented’
• ‘most effective strategies... Food pricing strategies, restrictions on marketing... Not reflected in RD food pledges’
• Most interventions clearly (37%) or possibly (37%) underway regardless of RD
• Analysis of trans fats pledge ongoing

Knai et al, Food Policy 2015
Net Costs with no Industry costs
Socio-economic differentials in outcomes

Outcome

Least deprived

Most deprived

Slope Index
Index of Multiple Deprivation (IMD)

- Defined at Lower-layer Super Output Area (LSOA) for England
  - 32,482 LSOA in total
  - Average population approx 1,500 per LSOA

<table>
<thead>
<tr>
<th>Domain</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Income Deprivation</td>
<td>22.5%</td>
</tr>
<tr>
<td>Employment Deprivation</td>
<td>22.5%</td>
</tr>
<tr>
<td>Health Deprivation and Disability</td>
<td>13.5%</td>
</tr>
<tr>
<td>Education, Skills and Training Deprivation</td>
<td>13.5%</td>
</tr>
<tr>
<td>Barriers to Housing and Services</td>
<td>9.3%</td>
</tr>
<tr>
<td>Crime</td>
<td>9.3%</td>
</tr>
<tr>
<td>Living Environment Deprivation</td>
<td>9.3%</td>
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## Sensitivity analysis input parameters

<table>
<thead>
<tr>
<th>MODEL PARAMETER</th>
<th>SENSITIVITY ANALYSIS</th>
</tr>
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<tbody>
<tr>
<td>TFA consumption</td>
<td>Normal distribution with assumed standard error of 10% of IMDQ-specific value (e.g., 1.2% ± 0.12%)</td>
</tr>
<tr>
<td>TFA link to CHD mortality</td>
<td>Normal distribution of meta-analysis coefficient (23% with 95%CI 11% - 37%)</td>
</tr>
<tr>
<td>Labelling response gradient</td>
<td>PERT distribution with mean 50%, min 20% and max 105% [20]</td>
</tr>
<tr>
<td>CHD mortality counterfactual</td>
<td>Normal distribution of the logit of the predicted rates based on upper and lower confidence intervals from model output [3]</td>
</tr>
<tr>
<td>CHD patient numbers (incidence)</td>
<td>Annual percent decline in patient numbers could vary from -5% (an increase of 5%) to 10%. A Pert distribution was used with a best estimate of 5% decline</td>
</tr>
</tbody>
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